The Micro-Thin Lens

A revolutionary optical element ideally suited for applications where space and weight limitations are important

We have solved the century-old problem of chromatic aberrations in diffractive optics and have experimentally demonstrated the micro-thin lens (MTL) by exploiting modern materials and microfabrication technologies. As a result of this innovation, the MTL is an ultrathin, ultralight-weight, and flexible optic that can be used for high-resolution, broad-band, light-weight applications where traditional refractive optics are either inefficient, too bulky, or do not exist (such as in the infra-red, ultra-violet, and x-ray regions). Since the MTL can easily be made multifocal and astigmatic, it becomes a very attractive lens for human vision corrections and for a variety of other applications–such as for displays, optical interconnects, sensors, optical communications, scanners, and optical memories.

Traditional diffractive optics

Although diffractive optics are not new, they have generally been limited to monochromatic applications because of chromatic aberration (the focusing of different colors of light by a lens to different locations). Because of this, traditional diffractive optics produce "rainbow-like" halos around objects illuminated with white light. Through innovations in microfabrication technologies and the use of modern materials, we have developed a diffractive lens that can image light without chromatic aberrations. As a result of these innovations, the MTL optic is less than 100-microns thick, is ultralight in weight, is flexible, and can thus be used for high-resolution, broad-band, light-weight applications.

APPLICATIONS

- *Human vision correction*
- *Compact (head-mounted) displays*
- *Projection optics and displays*
- *Space-home imaging*
- *Machine (computer) vision*

Human-vision applications for the Micro-Thin Lens

The primary human vision disorders are myopia, hyperopia, astigmatism, presbyopia, and cataracts. Vision corrections for these disorders take many forms, ranging from the use of simple glasses and contact lenses to surgical procedures for replacing the intraocular lens. The MTL has been developed at LLNL to address these primary vision disorders. The lens is extremely thin and flexible, making the MTL very attractive for human vision correction. After removing the epithelial layer from the cornea (a simple, painless, and nonsurgical procedure) it is believed that the MTL can then be placed on the Bowman's membrane, after which the epithelial layer will regenerate itself, covering and securing the lens in place. Since the MTL lens can be made over a large range of optical powers, or as a bifocal or astigmatic lens, it can address all the vision disorders listed earlier. We have already successfully made MTLs with optical powers ranging from 3 to 30 diopters (in air).

Industrial applications of the Micro-Thin Lens

Because of its unique physical properties, the MTL is ideally suited for applications requiring thin, light-weight optics. In particular, applications such as optical displays, interconnects, communications, and memories, as well as scanners and sensors, might have particular system requirements making use of the MTL beneficial. In addition, precision aspheric optics can easily be fabricated with this technology.

Availability: We want to pursue new and challenging applications for the MTL and to develop new industrial fabrication processes for their production.

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